Ultra Lightweight Reinforcement for Advanced High-Strength Steel Body and Closures

Mansour Mirdamadi
Deep Wang

Dow Automotive Systems
Presentation Outline

• Introduction to BETAMATE™ epoxy Light Weight Reinforcement (LWR)
• LWR material performance attributes
• Component testing studies
• LWR CAE validation studies
• Case studies
• Conclusions
BETAMATE Light Weight Reinforcement (LWR)

- What is LWR
  - Body shop applied BETAMATE epoxy material
  - Developed based on characteristics of highly toughened epoxy based adhesive
  - Designed to have expansion characteristics of 150%
  - Designed joint BIW substrates having gaps up to 15 mm
  - Highly mass efficient solution
  - Provide crashworthiness and body stiffness improvement
- Application method
  - Stream
  - Swirl
  - Bead
Substrate: 0.8mm HDG steel, Temperature exposure 30’ @ 170°C, Bond thickness 0.25mm
BETAMATE LWR Expansion Sensitivity

6mm

< 0.5mm  1mm  2mm  3mm

< 0.5mm

7mm

5mm  10mm  15mm  20mm  25mm  30mm  35mm  40mm  45mm  50mm  55mm  60mm  65mm  70mm  75mm  80mm  85mm  90mm  95mm  100mm  105mm  110mm  115mm  120mm  125mm  130mm  135mm  140mm

www.autosteel.org
Wedge impact peel performance of 9.0 N/mm
Cohesive failure mode
Plastic deformation of the substrate demonstrates BETAMATE LWR toughness
Class-A Read Through Studies

A: Roof panel to roof bow
   Observed read through
B: B-Pillar
   No visible read through
C: C-Pillar
   No visible read through
Prototype Component Tests

All layers are 0.8mm mild steel EG surface
High Speed Component Testing

20 MPH
70 lb mass
BETAMATE LWR CAE Correlation
Component Bending Response

Dynamic Bending

Quasi-static

Test A
Test B
CAE Predictions

Load [N]
Deflection [mm]

Test
Analysis, SSEF=25%
Vehicle Crashworthiness Fit
B-Pillar Side Impact Component Study

B-Pillar inner: DP590
B-Pillar outer/outer reinforcement: DP980

Requirements
Peak load of 50 kN
Peak bending moment of 10.5 kN.m

Assumptions: 1kg of mass savings worth $5 kg
**B-Pillar Side Impact Component Study**

Added LWR mass = 197g  
B-Pillar outer 1.2 $\rightarrow$ 1.0 mm  
Reinforcement 1.6 mm $\rightarrow$ 1.4 mm  
Sheet metal saving of 1.0 kg

Cost increase delta on based on material  
$2.67
BETAMATE LWR Roof Crush Study

Notes:
1. Dimensions in mm
2. Not to scale
BETAMATE LWR Location Sensitivity Study

Total LWR Mass: 4.65 kg
• The critical locations for LWR
  – LWR 8: B-pillar
  – LWR 1: A-pillar middle joint
  – LWR 7: C-pillar upper joint
  – LWR 3: A pillar upper joint
    - reinforcement (Negative)
  – LWR 6: Roof rail rear gap

• The critical interaction variables
  – LWR 3 * LWR 4
  – LWR 2 * LWR 4 (Negative)
  – LWR 3 * LWR 6 (Negative)
• The optimum LWR mass is 1.14 kg
• Peak force is 63.0 kN, increase 21%
BETAMATE Application to IIHS Narrow Offset

Baseline vehicle response

BETAMATE toughened epoxy body flange bonding ~ 100 m

BETAMATE LWR body cavity treatment

ULWR Optimized #2 0.9kg/side
BETAMATE Application to IIHS Narrow Offset

Baseline

BETAMATE CDA Flange Bonding

BETAMATE CDA Flange Bonding & LWR

BETAMATE LWR body cavity treatment
Intrusion improvement benefits
Conclusions

- LWR will enable OEMs and Tiers to reinforce small body cavities with highest performance and lowest mass by using proven crash durable bonding technology
- LWR provides opportunity to
  - Outperform conventional expandable adhesive solutions. Less mass is required in achieving same level of performance
  - Enhance energy absorption and load-transfer between body structure components
  - Join sheet metal components where gaps and joining is not suitable for conventional metal joining or conventional adhesive bonding
  - Optimize body components that are not traditionally considered in design process for meeting new safety and stiffness requirements
- Body shop applied material using the same dispensing equipment used for BETAMATE adhesive bonding
- Vehicle body strength/crashworthiness applications
  - IIHS side impact
  - Roof crush
  - Frontal moderate, and narrow offset impact
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